Conservation Systems Research

Cover Crops for Biofuel?

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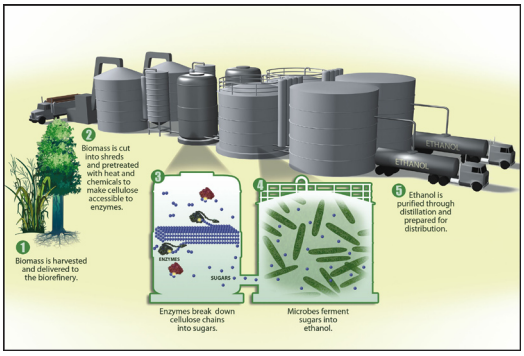

U.S. Department of Energy Genome Programs (http://genomics.energy.gov)

Cover crops are grasses, legumes, or small grains that are grown between regular cash crop growing seasons to reduce soil erosion, improve soil organic matter, and conserve soil moisture by increasing the amount of residue on the soil surface. The climate and land resources of the Southeast make cover crops an important conservation option for farmers. Ample rainfall and moderate temperatures during late fall and winter allow growth of high-quality cover crops, protecting the soil when it is most vulnerable. Growing these in conservation tillage systems, with their residue left on the soil surface, can lead to improved soil and water quality, better crop production, and greater profits on the farm.

Fall-planted cover crops (rye, wheat, clover, other winter legumes, brassicas, etc.) following summer cash crops can be planted and established before winter temperatures slow growth. When temperatures rise in the late winter and early spring, cover crops can grow rapidly and produce large amounts of biomass before summer cash crops are planted. Other cover crop species, such as sunn hemp or radish, can be planted in the late summer or fall and produce a good amount of biomass before winter frosts. Some covers, such as buckwheat, can be grown during the spring or summer for just a few weeks and still provide benefits for the soil and fall-planted crops.

Cover crops as a part of conservation systems are beneficial in a number of ways. Under the soil surface, cover crop roots open channels in the soil and feed microorganisms and soil fauna. On the soil surface, cover crop residue protects the soil and the growing cash crop. Increased soil organic matter from cover crop residue improves soil structure, nutrient retention, and water storage.

Economic Benefits of Cover Crops

Cover crops add organic matter, improve water and nutrient efficiency, and reduce pest, disease, and temperature stresses on following cash crops. The major economic benefits of cover crops, therefore, are increased cash crop yields, reduced risk due to less year-to-year variability in cash crop yields, and potentially reduced herbicide, irrigation, and fertilizer costs.

Costs of Cover Crops

Including cover crops in a cropping system requires good management. Cover crops should be grown tall and thick to maximize benefits and justify establishment and management costs. Cover crops that produce too little biomass may not provide enough benefit to justify the cost of the cover crop. Furthermore, early establishment is important to get maximum production from the cover before the following cash crop is established.

Costs of Planting and Managing Two Winter Cover Crops ($/acre).

Item	Cereal Rye	Crimson Clover
Seed	$20	$24
Fertilizer	11	0
Labor	6	3
Machinery	12	6
Fuel	4	2
Other	5	3
Total Cost of Operations	**$58**	**$38**

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Belowground Benefits of Cover Crops

1. Living cover crop roots secrete biochemical compounds that are a source of energy for soil organisms. Some of these compounds also inhibit germination and growth of weeds.
2. Roots scavenge plant nutrients left in the soil from earlier crops and recycle them for future use. Roots also create channels through the soil that, when they decay, allow air and water movement through the soil profile.
3. Decomposing roots add organic matter throughout the soil that feeds soil organisms. The organic matter improves soil structure, increasing water infiltration and storage.
4. Legume covers add nitrogen to the soil, potentially reducing fertilizer requirements for the next cash crop.
5. Increased biological activity in the soil often suppresses diseases and pests, and speeds up nutrient recycling.

Benefits from Surface Residue

1. Cover crop residue cushions the impact of raindrops, protecting the soil from crusting. This increases infiltration and reduces surface water runoff and erosion. Irrigation costs can be reduced when the soil can accept greater amounts of water at a time.
2. Residue moderates high summer temperatures and evaporation.
3. Thick residue inhibits weed germination and growth. Biochemicals that leach out of the residue can also impede weed growth.
4. Surface residue decomposition provides additional organic matter to the soil ecosystem.
5. Decomposing residue releases nutrients that will be available to the next cash crop.

Cover Crops for Biofuels

One of the hottest topics in the agricultural community lately has been biofuel production from agricultural crops. Current biofuel production methods use plant sugars and starches to make ethanol, which is then blended with gasoline to produce alternative fuels.

The next generation of biofuels will probably be cellulosic types, derived from plant cellulose and lignin that are much more plentiful than starches and sugars. Cellulose is available in all living plants and in many waste products, including agricultural residues. Perennial plants, such as switchgrass, are getting a lot of attention. However, many growers in the Southeast who can produce large amounts of cover crop biomass are wondering if that residue might also be valuable as a biofuel source without harming their soil quality.

Cover crops are grown mainly for their beneficial effects on soil quality and on the productivity of the following cash crop. Some of the beneficial effects are due to the belowground root growth; other effects are more related to the residue left on the soil surface. Removing residue for biofuel production would have more impact on the surface residue-related effects and less impact on the belowground ones.

Grow it tall and thick to maximize benefits and to cover costs.

Making a Choice

The bottom line for a grower is to weigh the economic and environmental costs and benefits of harvesting residue for biofuel against leaving it for soil quality benefits and the following cash crop. To be profitable, the returns from selling cover crop residue must be greater than any additional management costs (harvesting, baling, and transporting the residue to a refinery) plus any negative effects on soil quality or the following cash crop yields.

Economic Benefits and Costs of Using Covers for Biofuel

Benefits:

- Increased revenues from sale of cover crop residue to a refinery.

Costs:

- Increased management costs for sale of residue – harvesting, baling, transport to refinery.
- Increased cover crop management costs to maximize residue production – greater seeding rates and fertilizer needs.
- Increased cash crop management costs to replace residue effects – herbicides, fertilizers, irrigation.
- Potentially lower cash crop yields.
- Increased risk from greater year-to-year yield variability.
- Extending cover crop season to maximize growth may reduce window of time to plant cash crop and deplete soil moisture.

Environmental Costs of Using Covers for Biofuel

Harvesting cover crop residue would leave less on the surface and reduce residue effects on soil quality and the following cash crop. The soil surface would be less protected from crusting, so water runoff and erosion might increase. Less organic matter and nutrients from the residue would be returned to the soil. Pest control might be less effective.

Costs:

- Increased water runoff and surface water contamination.
- Higher surface temperatures and greater evapotranspiration.
- Decreased organic matter additions to soil ecosystem.